Mars Magnetoshell Decelerator EDL-SA study

Completed Technology Project (2016 - 2017)

Project Introduction

A recent NIAC phase I study (Kirtley et. al.) demonstrated experimentally a subscale magnetoshell with a 1000:1 increase in aerodynamic drag for a 1.6 meter argon magnetoshell, and a system study showed that aerocapture for a 60 mt payload, following the DRA5 reference architecture, using a 2.5 m magnet generating a 21 m radius magnetoshell, potentially eliminated the need for a dedicated aerocapture TPS. However, the NIAC phase I study did not align with well the existing Mars EDL-SA architecture studies. Additionally, the NIAC phase I study showed that magnetoshell decelerators may be situated better for large, unmanned missions and aerobraking than manned missions that would require aerocapture. The goal of this proposed IRAD study is to follow the year one focus of the EDL-SA Exploration-class study approach, using the same ground rules/assumptions and figures of merit, to compare a magnetoshell based EDL system for a 40 mt landed payload with the other EDL-SA exploration architectures, delivering a comparison white paper report along with the generated aerodynamic database and developed models at the end of the study.MSNW, LLC has been awarded a Phase II NIAC study to investigate the 3D orbital entry and capture mechanics; investigate the thermal, structural, electrical, and magnetic system requirements of a magnetoshell decelerator; conduct a hypersonic plasma-neutral interaction validation study; develop a detailed aerocapture orbital gravity model based on the satellite tour design program (STOUR); and evaluate cost and risk of a magnetoshell aerocapture system. This IRAD study would complement the MSNW, LLC NIAC study by developing an architecture study to allow a direct comparison between the magnetoshell decelerator concept and other deployable EDL technologies being developed at Langley and Ames.

Anticipated Benefits

Round-trip manned missions to Mars will require heavy entry descent and landing systems. Aerocapture could accomplish over 95% of the required orbital insertion delta-V with a savings of propellant mass, however the resulting thermal and aerodynamic loads on the spacecraft require an aeroshell/heatshield for protection. Deployable aeroshells like the mechanical ADEPT and inflatable HIADS2 come at the potential expense of additional mass, system complexity, and risk. A magnetoshell decelerator could provide the necessary aerocapture orbital insertion delta-V while possibly reducing the additional mass, complexity, and risk associated with mechanical and inflatable deployable aeroshells.

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Center Innovation Fund: LaRC CIF

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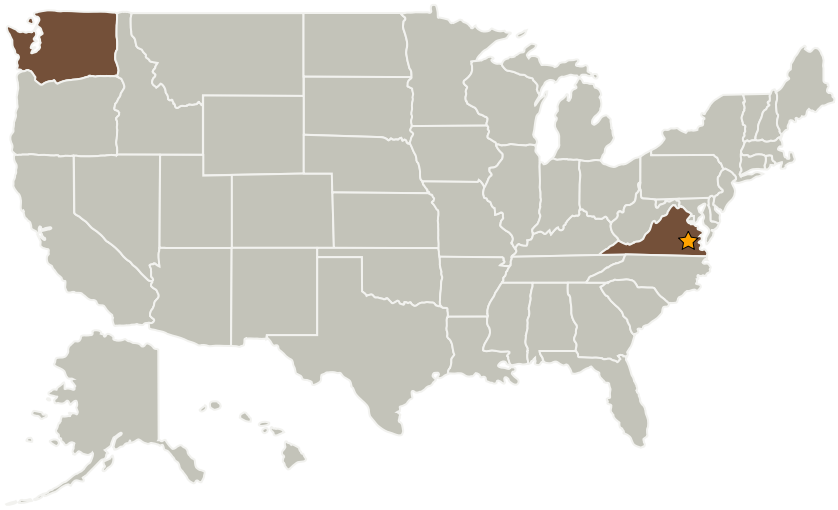
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia
MSNW, LLC	Supporting Organization	Industry	Redmond, Washington
Science Systems and Applications, Inc.(SSAI)	Supporting Organization	Industry	Hamtpon, Virginia

Primary U.S. Work Locations	
Virginia	Washington

Project Management

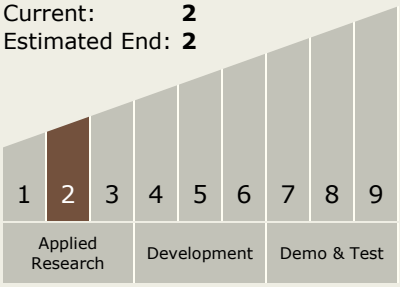
Program Director:
Michael R Lapointe

Program Manager:
Julie A Williams-byrd

Principal Investigator:
Robert W Moses

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **2**



Technology Areas

Primary:

- TX09 Entry, Descent, and Landing
  - TX09.1 Aeroassist and Atmospheric Entry
    - TX09.1.2 Hypersonic Decelerators

Target Destination

Mars